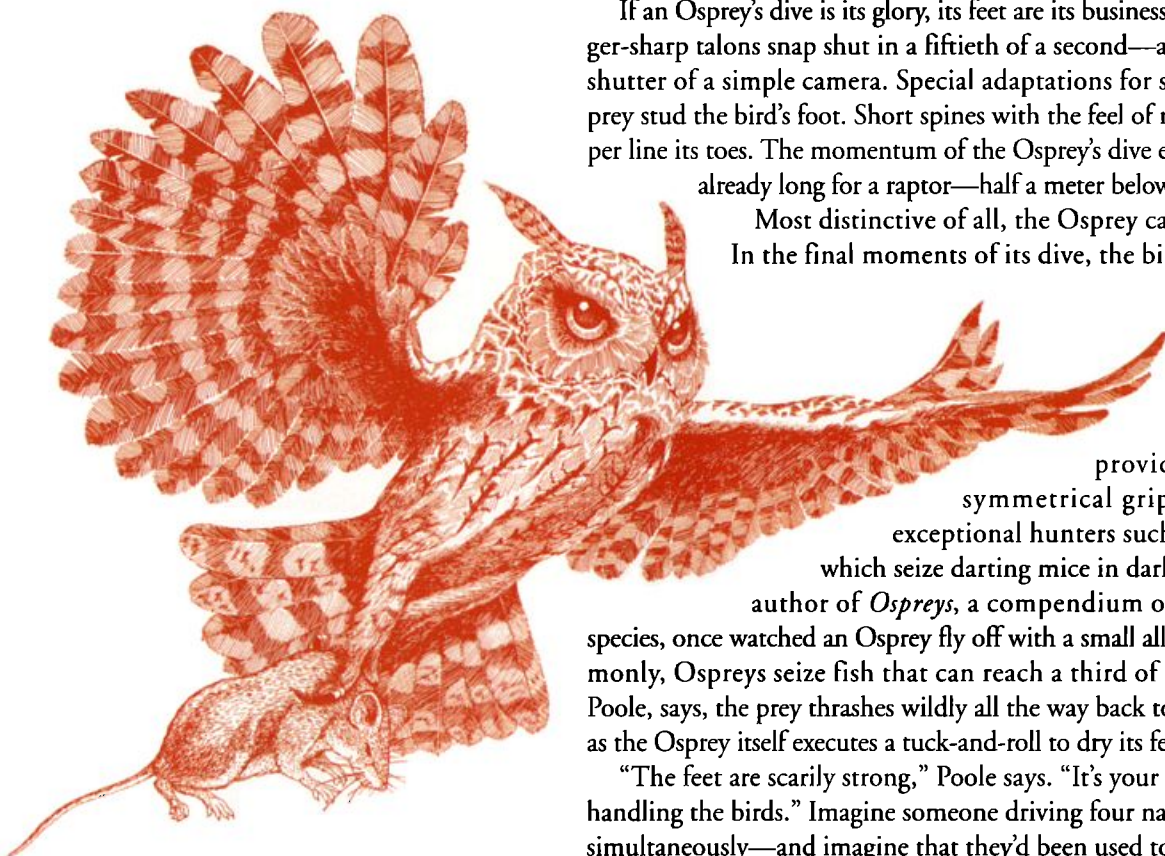


WEAPONS to CRADLE

Birds put the toe to the task. JAMES R. POLSON

ILLUSTRATIONS BY
PATRICK J. LYNCH



EASTERN
SCREECH-OWL
(*Otus asio*)

THE OSPREY HUNTS WITH COURAGEOUS GRACE. After a soaring search—often above a hundred feet—it folds its wings into a tuck and plunges headfirst toward shallow water. It brakes only in the final instant, casting out its wings, tossing back its head, and thrusting its feet forward, talons flared like sets of ice tongs.

If an Osprey's dive is its glory, its feet are its business. Curved and dagger-sharp talons snap shut in a fiftieth of a second—about as fast as the shutter of a simple camera. Special adaptations for subduing slippery prey stud the bird's foot. Short spines with the feel of rough-grit sandpaper line its toes. The momentum of the Osprey's dive extends its reach—already long for a raptor—half a meter below the surface.

Most distinctive of all, the Osprey can realign its toes. In the final moments of its dive, the bird rotates one toe

to the rear so that its four talons oppose each other. The configuration provides a powerful, symmetrical grip shared only by exceptional hunters such as screech-owls, which seize darting mice in darkness. Alan Poole, author of *Ospreys*, a compendium of research on the species, once watched an Osprey fly off with a small alligator. More commonly, Ospreys seize fish that can reach a third of their size. Often, Poole, says, the prey thrashes wildly all the way back to its captor's perch as the Osprey itself executes a tuck-and-roll to dry its feathers.

"The feet are scarily strong," Poole says. "It's your entire focus when handling the birds." Imagine someone driving four nails into your hand simultaneously—and imagine that they'd been used to clean fish. In the feet of raptors, form translates to fearsome function.

Although less striking in strength, the feet of other birds also prepare them to exploit their own ecological niche. A foot can disclose a bird's basic habits—how much time it spends in the air, on the ground, on or under the water. The panoply of birds employ their feet in a host of ways: from weapon in the Osprey to cradle for the Emperor Penguin. The short, flattened claws of Wild Turkeys scratch the ground for mast in fall, roots in spring. Swifts, near-perpetual flyers, retract their tiny feet into their plumage as they dart about for insects. Webbed toes propel most water birds. Grebes may achieve exceptional underwater agility

from a unique leg and foot that they rotate, or feather, like an oar.

A bird's feet and legs impose limits as well. An Osprey "walks like a drunken sailor" on its cumbersome talons, says Mark Pokras, an avian anatomist and wildlife veterinarian at Tufts University College of Veterinary Medicine who has treated captive raptors for foot infections. Grebes walk with such difficulty they build floating nests.

Still, most birds' feet are simple variations on a theme: three toes in front, one to the rear. The rear toe, called the hallux, works like the human thumb. It enables birds to grasp, and therefore to perch. For the most part, only waterbirds and large flightless birds like the ostrich lack this grasp. "Birds are arboreal creatures," says Alan Feduccia, author of *The Age of Birds*, a text on avian evolution. "Even the roadrunner spends half its time perching."

Perching is so essential that birds have evolved a mechanism that makes it effortless. Once a bird closes its toes around a perch, the toes latch. Ridges around each tendon interlock with ridges inside the tendon sheath "like two sides of a zipper," says Robert J. Raikow, the authority on bird musculature at the University of Pittsburgh.

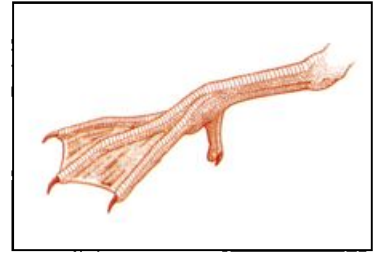
The shape of a bird's claws reveals whether it spends most of its non-flying time perching or foraging on the ground, Feduccia concluded after comparing the claws of 400 different birds. In an article in the journal *Science* (Vol. 259, 5 February 1993), he reported that with one exception, the claws of ground-dwelling birds are straighter than those of any perching or climbing bird. Birds with the most profoundly curved claws climb—although less curved claws don't preclude ability to scale a trunk.

Feduccia used his inventory to argue that *Archaeopteryx*, the oldest feathered creature known to science, perched in Jurassic trees—perhaps after using deeply curved claws on the leading edge of its wing to climb there. This has reinvigorated a continuing debate: Did flight evolve first among climbing creatures that glided from heights, as Feduccia argues, or among runners that bounded along the ground and eventually became airborne? "On the ground, *Archaeopteryx* was probably dinosaur meat," Feduccia says.

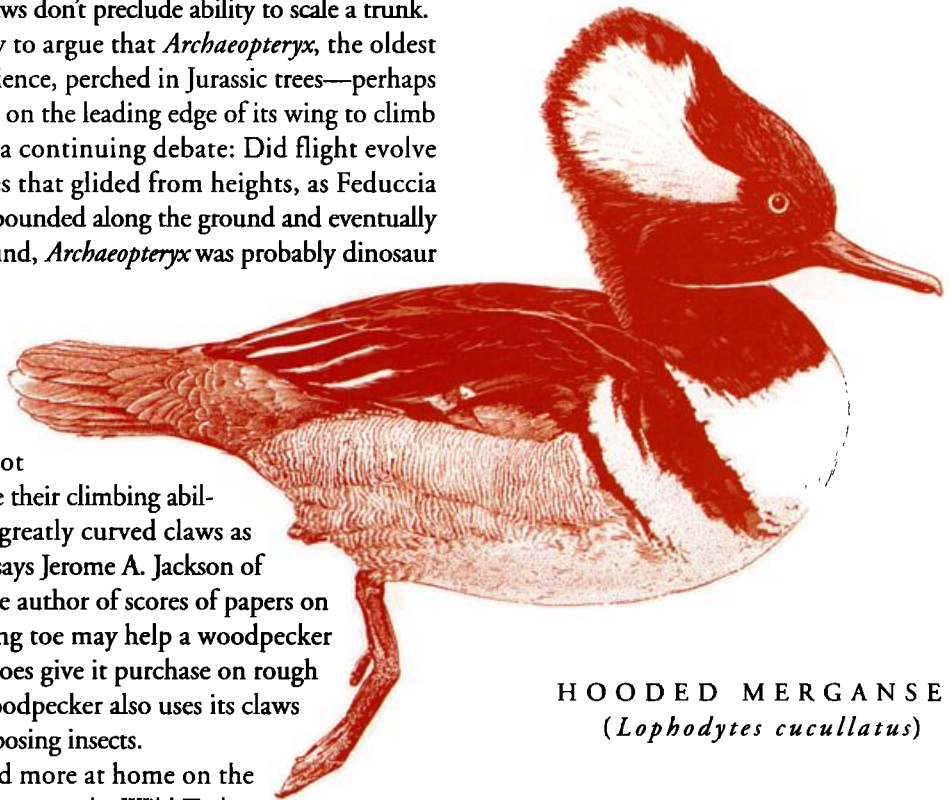
Other ornithologists agree that the curve of a bird's claw seems an essential adaptation to its niche. Although woodpeckers have a toe on each foot that grips outward, picids derive their climbing ability as much from their sharp, greatly curved claws as from the placement their toes, says Jerome A. Jackson of Mississippi State University, the author of scores of papers on woodpeckers. The side-gripping toe may help a woodpecker sidle around a trunk. Curved toes give it purchase on rough bark or smooth. A foraging woodpecker also uses its claws to tear away chunks of bark, exposing insects.

Straighter claws place a bird more at home on the ground. Flat claws and stout toes serve the Wild Turkey to scratch the ground for food—yet the bird can roost in tall trees, safe from predators. Long toes and claws spread out so much of the Purple Gallinule's weight it can fish from lily pads. Dozens of birds exploit subtle variations between those themes.

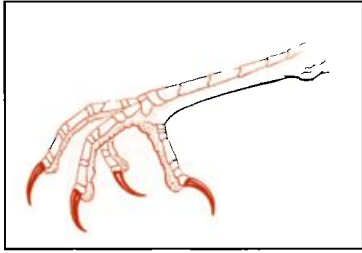
Take the wading birds, all long-toed enough to stroll soft, muddy bot-



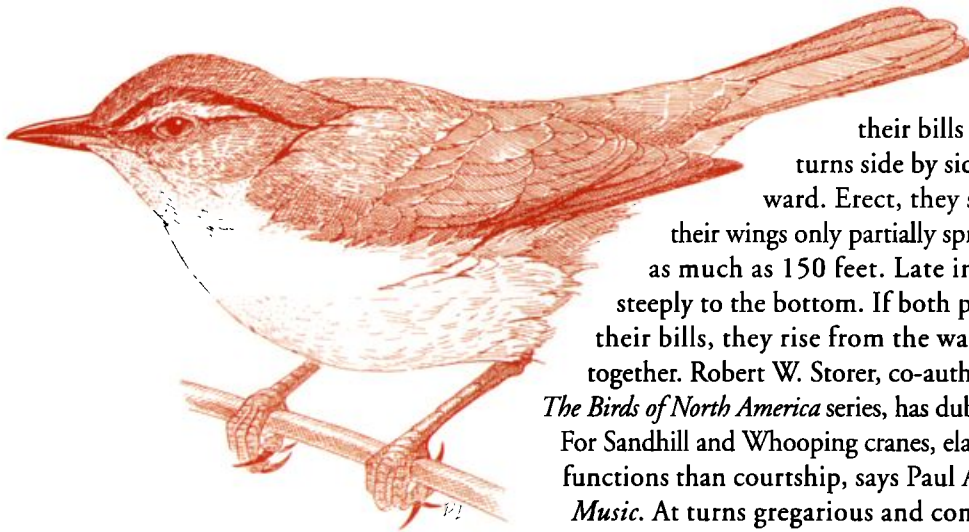
A dabbling duck uses its webbed foot to paddle and steer. Above, a Mallard foot. Below, diving ducks such as mergansers use their feet to navigate underwater.



HOODED MERGANSER
(*Lophodytes cucullatus*)



Perching birds easily grasp branches or wires. Above, the foot of a Blue Jay. Below, vireos often feed high in canopies, where a sure foothold is crucial.



RED-EYED VIREO
(*Vireo olivaceus*)

toms. Seconds after landing, a Great Blue Heron settles into absolute stillness, as if to mimic a tuft of marsh grass, its dusky feet nearly invisible to fish. Only its eyes swivel as it waits for prey to swim within reach of its bill. Fishing in the same salt marsh as the Great Blue, the Reddish Egret deploys a contrasting strategy. It charges through the water and then back tracks, sometimes shading the water with its wings. Heron behaviorist Douglas Mock of the University of Oklahoma assumes the Reddish Egret is flushing quarry—he has also seen it rake its toes through marsh grass, snapping at fleeing prey. The Snowy Egret often dangles its bright yellow foot under the surface, perhaps as a lure.

Some wading birds can swim, but none can match the ability of waterfowl, such as ducks. Dabbling vigorously through mats of duckweed, a Mallard can pivot nimbly, using its webbed feet both to paddle and to steer—somewhat as a canoeist executes a j-stroke. Yet the merganser, a diving duck, can swim rapidly enough to assist its takeoff. As the bird rises, it splashes across the surface until fully airborne.

In place of the webs that join the toes of other swimming birds, leathery lobes line the toes of a grebe. Long scales like those of a snake's belly add rigidity. In place of claws, grebes grow nails resembling those of a human hand. On the power stroke, the lobes flare into a paddle. On recovery, the grebe rotates its foot 90 degrees, reducing drag somewhat the way human swimmers feather their hands during the breast stroke.

The grebe dives with exceptional agility. In a 1947 study of Western Grebes, zoologist George E. Lawrence described five dramatically different dives. With a drop of the head and a vigorous stroke of the feet, for example, a Western Grebe can vanish, scarcely leaving a ripple.

Western Grebes use their feet most dramatically in courtship. After preliminary pointing and shaking of their bills at one another, a pair of birds turns side by side and lunges upward and forward. Erect, they sprint across the surface with their wings only partially spread. Such "rushing" may cover as much as 150 feet. Late in their courtship a pair dives steeply to the bottom. If both partners emerge with weeds in their bills, they rise from the water, feet churning, and come together. Robert W. Storer, co-author of the account on grebes in *The Birds of North America* series, has dubbed this the weed dance.

For Sandhill and Whooping cranes, elaborate dances serve more social functions than courtship, says Paul A. Johnsgard, author of *Crane Music*. At turns gregarious and combative, cranes may dance to defuse conflict and establish social class. Cranes enter the world aggressive: Nestlings sometimes kill their siblings. Yet adults usually mate for life, and a flock may hold together for decades. "There is strong pressure for socializing, just as in some ways people are social animals yet there is a hell of a lot of aggression," Johnsgard says.

The timing, duration, and movements of a Sandhill Crane dance are as unpredictable as the dance is majestic. Dancing often spreads like contagion. Birds stretch their wings, pump their heads, march, leap, and commonly fling sticks aloft. Myth credits dancing cranes as inspiration for the Greek alphabet. "It's one of the most beautiful things you can see in birding," says Johnsgard, who spends his springs watching cranes

dance along the North Platte River in western Nebraska.

Although elegant fliers, cranes have adapted to spend most of their lives on the ground. With only a vestigial hallux, Whoopers and Sandhills cannot perch, so they roost on islands or sandbars. Most flights are commutes from the roost to nearby grassland or field to forage.

Swifts, by contrast, have adapted to live almost exclusively in the air. By some estimates, a Chimney Swift can fly 135,000 miles a year—about the equivalent of five and a half flights around the globe. Some Chimney Swifts breed in North Dakota and winter in Chile. Swifts feed, court, and mate on the wing. Studies of Common Swifts using radar and bird-mounted altimeters show they can stay aloft night and day. They need not alight even to construct a nest. Chimney Swifts can snap off twigs in flight, says biologist Charles T. Collins, who has studied western swifts for two decades.

As an aerialist, the swift has evolved feet tiny enough to disappear into its plumage, enhancing the bird's aerodynamics. Contracted, a Chimney Swift's foot may be little larger than a grain of rice—half the size of the foot of a smaller warbler. The scientific name for the swift family, Apodidae, means “no feet” in Latin.

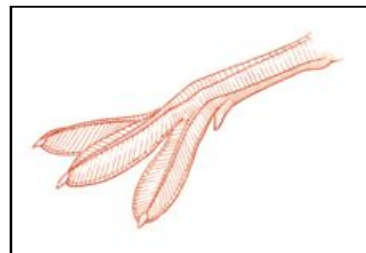
Its diminutive feet make the swift awkward on the ground but not helpless, says Collins, a professor at California State University at Long Beach. All swifts can perch on their own nests, or grip crevices in caves or chimneys. Palm Swifts of the Caribbean and South America can climb palm fronds, using a side-to-side grip that Collins likens more to that of a chameleon or a koala than to any known bird. Other members of the Palm Swift's subfamily, the Common Swift of Europe and the White-throated Swift of the American West, share the unique grip.

The Emperor Penguin can neither perch nor climb, and it “flies” through water rather than air. Yet no bird puts its feet to more generous use. The Emperor's feet guard its egg, and later, its young from some of the most hostile weather on the planet. In the Antarctic autumn, the female Emperor lays a single egg on the sea ice, then plunges into the sea for an extended fishing trip.

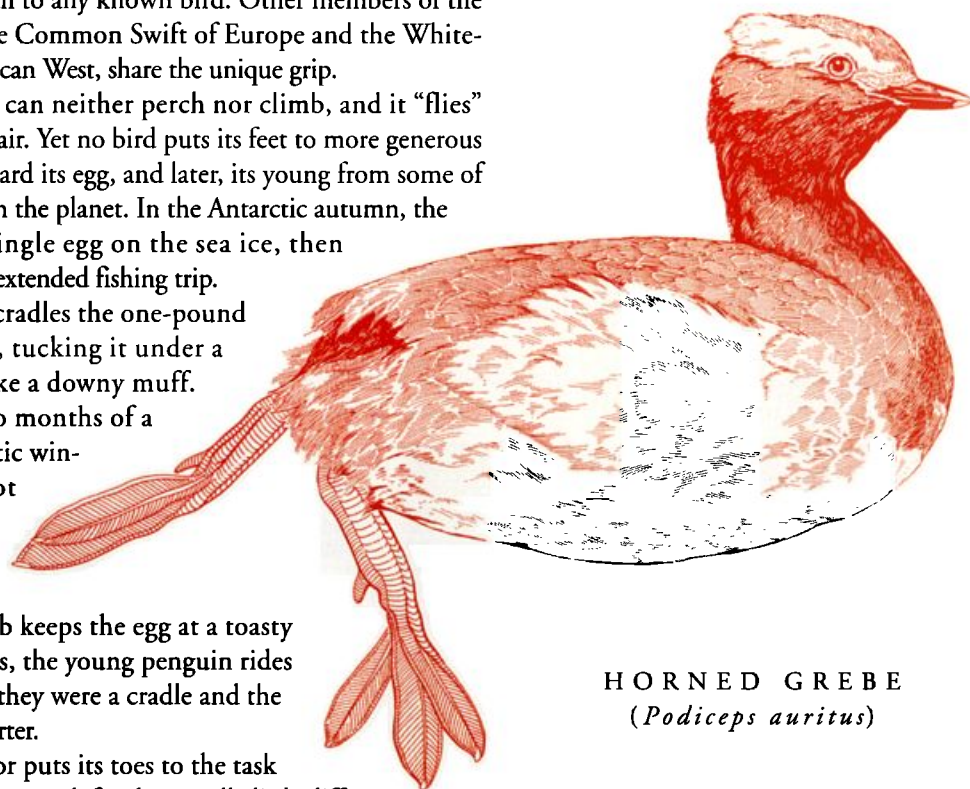
Left behind, the male cradles the one-pound egg on the top of its feet, tucking it under a large fold of belly skin like a downy muff. Throughout the next two months of a continuously dark Antarctic winter, as the ice underfoot thickens and the air temperature may fall to -70°F amid howling winds, this paternal womb keeps the egg at a toasty 97°F. After the egg hatches, the young penguin rides upon its parents' feet as if they were a cradle and the muff were a copious comforter.

In this way, the Emperor puts its toes to the task of the survival of its species—a task fundamentally little different from that of a grebe courting its mate, or an Osprey delivering to its nestlings a gasping, defeated herring. ♣

—James R. Polson is a graduate student in Science Journalism at Boston University. He has written on conservation issues for the Atlanta Constitution.



Grebes have lobed feet which are placed far back on its body. This gives the bird maximum power while diving. Above, the foot of a Horned Grebe.



HORNED GREBE
(*Podiceps auritus*)